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DERMACENTOR TICKS (ACARI: IXODOIDEA: IXODIDAE) OF THE NEW WORLD: A SCANNING ELECTRON MICROSCOPE ATLAS

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Abstract.—The cosmopolitan, mostly Holarctic genus *Dermacentor* is represented in the New World by 12 species, some of which are important vectors of disease to man and animals. Existing diagnostic keys, usually based on line drawings, are useful principally to specialists or to those with access to reference specimens. We have investigated New World *Dermacentor* spp. by scanning electron microscopy (SEM) and found salient characters useful in identification by the nonspecialist. A key to females and males of New World species, illustrated by SEM photographs, is presented. Listings of geographical distribution and disease relationships are given for each species.

From a combined medical and veterinary standpoint, the most important ticks of North America are species of the genus *Dermacentor*. Existing diagnostic keys to taxa within this genus are based on national confines or subdivisions (Cooley, 1938; Gregson, 1956; Brinton et al., 1965; Strickland et al., 1976; Furman and Loomis, 1984). However, the predilection of many *Dermacentor* spp. for livestock or other large mammals that range widely or are regularly transported by man compromises the reliability of these keys. In addition, key characters are conventionally illustrated by pen and ink drawings, a device adequate for taxonomic specialists but of limited utility to field workers and those without access to reference specimens. Recently, the scanning electron microscope (SEM) has been employed to illustrate morphological features in descriptive and comparative studies of ticks (Keirans et al., 1982; Clifford et al., 1983; Hoogstraal et al., 1983) and has proven particularly useful in diagnostic keys (Keirans and Clifford, 1978; Sonenshine, 1979). We have identified and illustrated salient characters of New

World *Dermacentor* spp. by use of scanning electron microscopy and present keys to males and females. The keys were designed so that they may be used by investigators lacking access to an SEM or to voucher specimens; it is believed that they will facilitate preliminary identification of field-collected specimens by entomologists, parasitologists, epidemiologists, public health workers, veterinarians and other nonspecialists.

No attempt has been made to produce complete descriptions of species. Adequate written descriptions may be found in the existing literature (see below), which should be consulted in order to confirm tentative diagnoses made by use of these keys. We also provide updated information on geographic distribution, based largely on unpublished records of the Rocky Mountain Laboratories (RML) tick collection, now permanently housed in the Entomology Department, Museum Support Center, Smithsonian Institution, Washington, D.C.

This work is dedicated to Dr. Harry Hoogstraal (1917–1986), our colleague and our friend.

Distribution

Ticks of the genus *Dermacentor* are members of the acarine family Ixodidae and, together with those of the genera *Cosmiomma, Anomalohimalaya, Rhipicentor, Rhipicephalus, Boophilus* and *Margaropus,* form the subfamily Rhipicephalinae. The genus *Dermacentor* is cosmopolitan in distribution and may be encountered on all continents except Australia; however, the species have apparently evolved in the Nearctic Region, where the greatest biological diversity is displayed (Belozerov, 1976). In the New World, 12 species comprise about 40% of the world's total (Table 1). Here, the geographic range of the genus extends from Canada to Argentina, with the largest number of species being located in North America including Mexico. The latter are: *D.* (*Anocentor*) *nitens* Neumann 1897, *D.* (*Dermacentor*) *albipictus* (Packard 1869) (= *Ixodes nigrolineatus* Packard 1869), *D.* (*D.*) *andersoni* Stiles 1908 (= *D. venustus* Marx in Neumann 1897), *D.* (*D.*) *halli* McIntosh 1931, *D.* (*D.*) *hunteri* Bishopp 1912, *D.* (*D.*) *occidentalis* Marx 1892, *D.* (*D.*) *parumapertus* Neumann 1901, and *D.* (*D.*) *variabilis* (Say 1821). Of these, only three species, *D.* (*D.*) *albipictus, D.* (*D.*) *andersoni,* and *D.* (*D.*) *variabilis,* are found north of the U.S.-Canada border, while some are also found in Central or South America. The tropical horse tick, *D.* (*A.*) *nitens,* ranges from the southern United States throughout most of the American tropics to northern Argentina; *D.* (*D.*) *albipictus* has been reported in Guatemala, and *D.* (*D.*) *halli,* as far south as Panama. Two *Dermacentor* species are restricted to Central America: *D.* (*D.*) *dispar* Cooley 1937, and *D.* (*D.*) *latus* Cooley 1937; a third species, *D.* (*D.*) *dissimilis* Cooley 1947, is found in Mexico and Central America. A fourth Neotropical species, *D.* (*D. imitans* Warburton 1933, occurs in both Central America and northwestern South America.

Medical and Veterinary Importance

Ticks are the most important vectors to domestic animals of agents of infectious disease and are second only to mosquitoes as transmitters of pathogenic microorganisms to man. In addition, ticks, including dermacentors, may cause a deadly paralysis in man and animals through injection of a toxin, as well as death of

Table 1. New World *Dermacentor* ticks: distribution and hosts.

Tick	Distribution	Hosts
D. nitens	Tropical and subtropical areas of North, Central and South America, including Caribbean and Galapagos Is.	All stages: equids and ruminants
D. dispar	Central America	Adults: peccary, deer
D. dissimilis	Mexico, Central America	All stages: equids and ruminants
D. parumapertus	W USA; Mexico	All stages: principally lagomorphs, but deer and cattle are also attacked
D. imitans	Mexico; Central and South America	Adults: principally tapirs, but also other larger mammals, including man Immatures: small mammals
D. halli	Texas, USA; Mexico; Central America	Adults: larger mammals, including man Immatures: small mammals
D. latus	Central America	Adults: principally tapirs
D. hunteri	SW USA; Sonora and Baja California Norte, Mexico	Adults: principally desert bighorn sheep
D. albipictus	Canada, USA, Mexico, Central America	All stages: principally ruminants and equids, rarely on man
D. occidentalis	Pacific Coast of North America from Oregon, USA to NW Mexico	Adults: larger mammals, including man Immatures: small mammals
D. andersoni	Western Canada and USA	Adults: larger mammals, including man Immatures: small mammals
D. variabilis	Central and E Canada; USA east of Rocky Mountains; E Mexico to Yucatan; also localized foci of California, Oregon, Washington and Idaho, USA	Adults: medium and large-sized mammals, including man Immatures: small mammals

heavily parasitized animals through exsanguination. Other effects of tick-feeding on livestock and wildlife include anemia, weakness, weight loss, tick worry, secondary infection or invasion of tick-bites by microorganisms or screwworms, damage to hides and udders, and loss of drayage capability and manure (Furman and Loomis, 1984; Strickland et al., 1976; Anonymous, 1984). Old World dermacentors, particularly in Europe and Asia, are involved in the transmission to domestic animals of *Anaplasma ovis, Babesia bovis, B. caballi, B. canis, B. equi* and *Theileria ovis.* They are also important vectors of Congo-Crimean hemorrhagic fever, Russian spring-summer encephalitis, *Rickettsia siberica,* Q-fever and tularemia, which cause human disease. A list of agents and disease conditions transmitted or caused by the various species of New World dermacentors is given in Table 2.

Table 2. New World *Dermacentor* ticks: involvement in human and animal disease.*

Agent	Disease	Host	Vectors
Rickettsia rickettsi	Rocky Mountain spotted fever	Man, various wild mammals	*D. andersoni, D. variabilis, D. occidentalis D. albipictus*(?)
Rickettsia rickettsi	Rocky Mountain spotted fever	Lagomorphs	*D. parumapertus*
Coxiella burnetti	Q-fever	Man, livestock	*D. andersoni, D. variabilis, D. occidentalis*
Chlamydia sp.	Psittacosis	Man, various wild mammals	*D. andersoni*(?), *D. occidentalis*(?)
Anaplasma marginale	Anaplasmosis	Cattle	*D. andersoni, D. variabilis*(?), *D. occidentalis, D. albipictus*(?)
Francisella tularensis	Tularemia	Man, various wild mammals	*D. andersoni, D. variabilis, D. occidentalis*
Francisella tularensis	Tularemia	Lagomorphs	*D. parumapertus*
Babesia caballi	Piroplasmosis	Horses	*D. nitens*
Orbivirus	Colorado tick fever	Man, various wild mammals	*D. andersoni, D. variabilis*(?), *D. albipictus*(?), *D. occidentalis*(?), *D. parumapertus*(?)
Flavivirus	Powassan encephalitis	Man, various wild mammals	*D. andersoni*
Toxin	Tick paralysis	Man, dogs, ruminants, equids	*D. andersoni, D. variabilis, D. occidentalis*

* Skin wounds predisposing to infection or screwworm attack, anemia, weakness, weight loss and death may occur in wild and domestic ruminants and equids infested with *D. nitens* or *D. albipictus.*

Material Examined

Specimens used for scanning electron microscopy were prepared by the method of Corwin et al. (1979). Specimens examined for this study are summarized in Table 3.

Glossary of Terms for Use with the Keys

Basis capituli: The basal portion of the capitulum of a tick on which the mouthparts are attached (Figs. 1, 16a).

Cervical grooves: A pair of grooves in the scutum extending posteriorly from anterior angles or "shoulders" of the scutum; may be shallow or deep, faint or absent (Fig. 10).

Cornua: Small projections extending from the dorsal, posterolateral angles of the basis capituli (Figs. 51, 52).

Coxae: Small sclerotized plates on the venter representing the first segment of the legs (Figs. 5–8).

Dorsal prolongation: The posterodorsal extension of the spiracular plate (Figs. 22–24).

Emarginate: A section cut out or removed from the margin of the scutum.

Eyes: Simple light-gathering organs located on the lateral margins of the scutum in both adults and immatures.

Table 3. *Dermacentor* spp. examined by scanning electron microscopy.

RML #	Species	Host	Locality	Date	Collector
23576	*D. albipictus*	*Alces alces*	Montana, USA	III.1947	G. Kohls, J. Brennan and W. Jellison
—	*D. andersoni*	RML Laboratory colony			
47638	*D. dispar*	*Dasypus novemcinctus*	Belize	II.1967	C.W.B. Hatherill
28469	*D. dissimilis*	Horse	Guatemala	XI.1950	H.T. Dalmat
29323	*D. halli*	Porcupine	Guatemala	IV.1951	H.T. Dalmat
11355	*D. hunteri*	*Ovis canadensis*	Arizona, USA	X.1935	G.M. Kohls
37973	*D. imitans*	*Tayassu tajacu*	Panama	V.1962	P. Gallindo
48959	*D. imitans*	*Homo sapiens*	Colombia	V.1967	G.B. Fairchild
34927	*D. latus*	Tapir	Panama	XII.1953	R. Hartmann
13302	*D. nitens*	Unknown	Nicaragua	V.1937	A. Fouseck
58857	*D. occidentalis*	On flag	Oregon, USA	IV.1972	R.A. Gresbrink
9265	*D. parumapertus*	*Lepus californicus*	Nevada, USA	VI.1940	G.M. Kohls and H. Sargent
—	*D. variabilis*	RML Laboratory colony	Virginia, USA		D. Sonenshine

Festoons: Uniform rectangular areas, separated by distinct grooves, located on the posterior body margin in females (Figs. 3, 4) and on the posterior scutal margin in males (Fig. 46).

Genital grooves: Long paired grooves diverging from each side of the genital opening and extending to the posterior body margin (Figs. 5, 6).

Genital opening: External opening of the genital organs. Located anteriorly on the ventromedian line, posterior to the basis capituli (Figs. 15, 17–18).

Goblet cells: Small, round structures located in the spiracular plate (Figs. 19–30). They may be small and numerous as in *Dermacentor variabilis* or large and few as in *D. nitens*.

Hypostome: Median ventral holdfast organ of the mouthparts that lies parallel to and between the palps and is immovably attached to the basis capituli. It bears recurved "teeth" or denticles (Figs. 1, 2).

Hypostomal dentition: Refers to the arrangement of denticles on the ventral aspect of the hypostome. The number of files of denticles is expressed by the dental formula. Thus, 3/3 dentition means that there are three files of denticles on each side of the median line of the hypostome.

Lateral grooves: The grooves running along the sides of the scutum in male *Dermacentor* species (Figs. 32, 34).

Palps: Paired articulated appendages located anterolaterally on the basis capituli (Figs. 1, 2). The sequence of numbering of the segments is by Arabic numerals 1–4, with 1 being the proximal segment (closest to the basis capituli). Segment 4 is usually reduced to a small setae-crowned papilla lying in a cuplike depression of segment 3.

Spiracular plates: Paired plates located ventrolaterally and posterior to coxa IV; they may be oval, round or comma-shaped (Figs. 19–30). They contain the openings of the respiratory system.

Trochanter: The second leg segment located distal to the coxa (Fig. 16).

The Genus *Dermacentor* in the New World

Key to ♀[1]

1. Hypostomal dentition 4/4, palpal segment 4 terminal (Fig. 1); festoons 7 (Fig. 3); scutum inornate; spiracular plate with few (e.g. 7) very large goblet cells (Fig. 19); tropical and subtropical areas of North, Central and South America, including Caribbean and Galapagos Is.; on equids and ruminants .... *D.* (*Anocentor*) *nitens*
– Hypostomal dentition generally 3/3 (variable in *D. dissimilis*), palpal segment 4 subterminal and ventral (Fig. 2); festoons 10 or 11 (Fig. 4); scutum usually ornate, spiracular plate with numerous goblet cells of small to moderately large diameters ...... *D.* (*Dermacentor*) spp. 2
2. Spurs of coxa I widely divergent (Figs. 5, 8) or only a single spur on coxa I (Fig. 7) 3
– Spurs of coxa I with proximal edges apposed or subparallel (Figs. 6, 14) 7
3. With a single spur on coxa I; genital opening surrounded by a circular groove (Fig. 7); goblet cells of spiracular plate homogeneously small and extremely numerous (Fig. 20); Texas, USA, Central America; on peccary and deer .... *D. dispar*
– With two spurs on coxa I; genital groove truncate anteriorly (Figs. 5, 6, 8, 12); goblet cells of spiracular plate various 4
4. Spiracular plate not comma-shaped (without dorsal prolongation), with relatively few (e.g. 36), moderately large goblet cells (Fig. 21); scutum emarginate at shoulders and posterolaterally (Fig. 9); internal coxal spurs II–IV absent (Fig. 8); hypostomal dentition variable (e.g. 4/4, 4/3, 3/4, 3/3): Central America; principally on horses and cattle ...... *D. dissimilis*
– Spiracular plate comma-shaped (with dorsal prolongation), with many small to large goblet cells (Figs. 22–24); scutum not emarginate (Figs. 10, 11); internal coxal spurs II–IV present or absent; hypostomal dentition 3/3 5
5. Most scutal setae arising from large, deep, evenly distributed pits; cervical grooves as long, deep troughs that widen and become shallower and rugopunctate posteriorly (Fig. 10); ornamentation of scutum, if present,

[1] Size ranges of goblet cells expressed as: small (≤10 μm), medium (10–20 μm), moderately large (20–40 μm), very large (>50 μm).

restricted to a whitish band on posterior margin and/or cervical groove area; central goblet cells of spiracular plate moderately large (Fig. 22); genital opening "V"-shaped (Fig. 12); SW United States and NW Mexico; principally on lagomorphs .... *D. parumapertus*

– Most scutal setae arising from small shallow punctations; cervical grooves subcircular, short, deep, more pitlike than troughlike (Fig. 11); ornamentation of scutum extensive; goblet cells small to medium; genital opening "U"-shaped, (Figs. 5, 13) 6

6. Goblet cells of spiracular plate all small (Fig. 23); genital opening surrounded by a demarcation; external coxal spurs II–IV short, broad; internals lacking (Fig. 5); Central America; principally on peccary .... *D. imitans*

– Goblet cells of mixed sizes, small to medium (Fig. 24); genital opening not posteriorly demarcated; coxae II–IV with long, narrow external spurs, II and III with short, broad internals (Fig. 13); SW United States, Central America; on various mammals, including man .... *D. halli*

7. Genital opening surrounded by circular groove, internal spur of coxa I longer than external (Fig. 14); spiracular plate with numerous homogeneously medium-sized goblet cells and a short, broad dorsal prolongation (Fig. 25); Central America; principally on tapirs .... *D. latus*

– Without above combination of characters 8

8. Dorsal prolongation of spiracular plate absent or reduced, plate surface nearly filled with moderately large goblet cells, bordered peripherally with, at most, a line of small pores (Fig. 26); internal spurs on coxae II and III; genital opening "U"-shaped (Fig. 6); North and Central America; principally on ruminants and equids .... *D. albipictus*

– Dorsal prolongation of spiracular plate present, usually well-developed; goblet cells of various sizes and distributions; internal spurs of coxae II and III present or absent; genital opening "U" or "V"-shaped 9

9. Spiracular plate with fewer (e.g. 50 or less) moderately large, widely spaced goblet cells; minute pores, if present, restricted mostly to dorsal prolongation (Fig. 27); genital opening "U"-shaped, containing paired labia (Fig. 15). SW United States, Mexico; principally on desert bighorn sheep .... *D. hunteri*

– Spiracular plate with numerous (e.g. 90 or more) close-set, small to moderately large goblet cells surrounded by one or more concentric rows of minute pores that extend into dorsal prolongation; genital openings various, but without labia; on medium-sized and large mammals, including man 10

10. Dorsal spur of trochanter I and cornua of basis capituli as long as or longer than wide (Fig. 16a); goblet cells of spiracular plate moderately large (Fig. 28); scutal punctations mostly small, sizes not greatly disparate; genital opening "V"-shaped (Fig. 17); Pacific coast, from Oregon, USA to Mexico .... *D. occidentalis*

– Dorsal spur of trochanter I and cornua wider than long (Fig. 16b); goblet cells small or moderately large; dorsal punctations of markedly disparate sizes, large and small; genital opening "U"-shaped (Fig. 18) 11

11. Goblet cells of spiracular plate moderately large, few; dorsal prolongation

of plate narrow (Fig. 29); western areas of Canada, United States .... *D. andersoni*

– Goblet cells of spiracular plate small, numerous; dorsal prolongation of plate broadly produced (Fig. 30); central and E areas of Canada and United States through E Mexico to Yucatan, also localized in California, Oregon, Washington, and Idaho .... *D. variabilis*

THE GENUS *DERMACENTOR* IN THE NEW WORLD
KEY TO ♂[1,2]

1. Hypostomal dentition 4/4, palpal segment 4 terminal (Fig. 1); festoons 7 (Fig. 3); lateral grooves absent (Fig. 31); spiracular plate with few (e.g. 7), very large goblet cells (Fig. 19); spurs of coxae I widely divergent, those of II–IV well developed; tropical and subtropical areas of North, Central and South America, including Caribbean and Galapagos Is.; on equids and ruminants .... *D.* (*Anocentor*) *nitens*

– Hypostomal dentition generally 3/3 (variable in *D. dissimilis*), palpal segment 4 subterminal and ventral (Fig. 2); festoons 11 (Fig. 4); lateral grooves present or absent (Fig. 32); spiracular plate with numerous goblet cells of small to moderately large diameters . . *D.* (*Dermacentor*) spp. . . . 2

2. Spurs of coxa I widely divergent (Figs. 5, 8) or only a single spur on coxa I (Fig. 7) 3

– Spurs of coxa I with proximal edges apposed or subparallel (Figs. 6, 14) 9

3. Each coxa with a single spur (Fig. 33); lateral margins of scutum produced as elevated ridges extending from eyes to spiracular plates, these ridges separated from festoons by deep clefts (Fig. 34); goblet cells of spiracular plate homogeneously small and extremely numerous (Fig. 20); Texas, USA, Central America; on peccary and deer .... *D. dispar*

– One or more coxae with paired spurs; scutum not as above; goblet cells various 4

4. Spiracular plate oval or subcircular (lacking dorsal prolongation) with relatively few (e.g. 33) moderately large goblet cells (Fig. 21); lacking lateral grooves on scutum and internal spurs on coxae II and III; coxae IV not greatly elongated proximally (Fig. 35); hypostomal dentition variable (e.g. 3/3, 3/4, 4/3, 3.5/3.5, 4/4; Central America; principally on horses and cattle .... *D. dissimilis*

– Spiracular plate with dorsal prolongation (variable in *D. albipictus*), goblet cells various but usually numerous (Figs. 22, 25, 26); lateral grooves of scutum and internal spurs of coxae II and III present or absent; coxae IV much longer proximally than distally (Fig. 36); hypostomal dentition 3/3 5

5. Most scutal setae arising from large deep pits, of which those of lateral groove coalescing, rugopunctate (Fig. 37); ornamentation of scutum usually reduced; spiracular plate comma-shaped, dorsal prolongation rela-

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[1] Some features shared by sexes are figured for ♀ only.

[2] Size ranges of goblet cells as in ♀.

tively long and narrow (Fig. 22); SW United States and NW Mexico; principally on lagomorphs .... *D. parumapertus*

– Most scutal setae arising from small pits or shallow depressions, of which those associated with lateral groove discrete (Fig. 38); scutum ornate; dorsal prolongation of spiracular plate often reduced or absent, when present arising from a broad base 6

6. External spur of coxa I longer than internal (Figs. 39, 50) 7

– External spur of coxa I shorter than internal (Fig. 45) 8

7. Goblet cells of spiracular plate all small, dorsal prolongation short, broadly rounded apically (Fig. 41); cornua longer than wide, broadly rounded apically (Fig. 43); spurs of coxae II–IV and most ventral setae reduced (Fig. 39); Central America; principally on tapirs .... *D. imitans*

– Goblet cells of mixed sizes, small to medium; dorsal prolongation long, apex as wide as base (Fig. 42); cornua wider than long, with blunt points (Fig. 44); coxal spurs and ventral setae normally developed (Fig. 50); SW United States, Central America; on various mammals, including man .... *D. halli*

8. Lateral grooves absent, but suggested by a linear row of deep pits extending from vicinity of eyes to festoons (Fig. 46); scutal setae shorter than diameter of pits that contain them; spiracular plate with numerous (e.g. >300), close-set, medium sized goblet cells (Fig. 25). Central America; principally on tapirs .... *D. latus*

– Lateral grooves absent or visible for only a short distance anterior of festoons (Fig. 49); scutal setae longer than containing pits; spiracular plate with fewer than 100 moderately large, goblet cells (Fig. 26). North and Central America; principally on ruminants and equids .. *D. albipictus*

9. Spiracular plate with long, attenuate dorsal projection and about 50 moderately large, widely spaced goblet cells; minute pores restricted mostly to dorsal prolongation (Fig. 47); SW United States, and Sonora and Baja California Norte, Mexico; principally on desert bighorn sheep .... *D. hunteri*

– Dorsal prolongation of spiracular plate shorter, less acute; goblet cells numerous (e.g. >90), close set, small to moderately large, and surrounded by one or more concentric rows of minute pores that extend into dorsal prolongation (Fig. 48); on medium-sized and large mammals, including man 10

10. Basis capituli longer than wide; dorsal spur of trochanter I and cornua of basis capituli as long as or longer than wide (Fig. 16a); cornua prominently elevated above median longitudinal area of basis (Fig. 51); sizes of scutal punctations not greatly disparate; pearl gray coloration of scutum more extensive than brown; Pacific coast, from Oregon, USA to Mexico .... *D. occidentalis*

– Basis capituli and cornua, as well as dorsal spur of trochanter I wider than long (Fig. 16b); cornua not prominently elevated above median longitudinal area of basis (Fig. 52); scutal punctations of markedly disparate sizes, ornamentation varying 11

11. Goblet cells of spiracular plate small, numerous (e.g. >300), dorsal prolongation broadly produced (Fig. 53); Central and E areas of Canada and

United States through E Mexico to Yucatan; also in localized foci of California, Oregon, Washington and Idaho .... *D. variabilis*

– Goblet cells of spiracular plate moderately large, fewer than 100, dorsal prolongation narrower (Fig. 54); western areas of Canada, United States and Mexico .... *D. andersoni*

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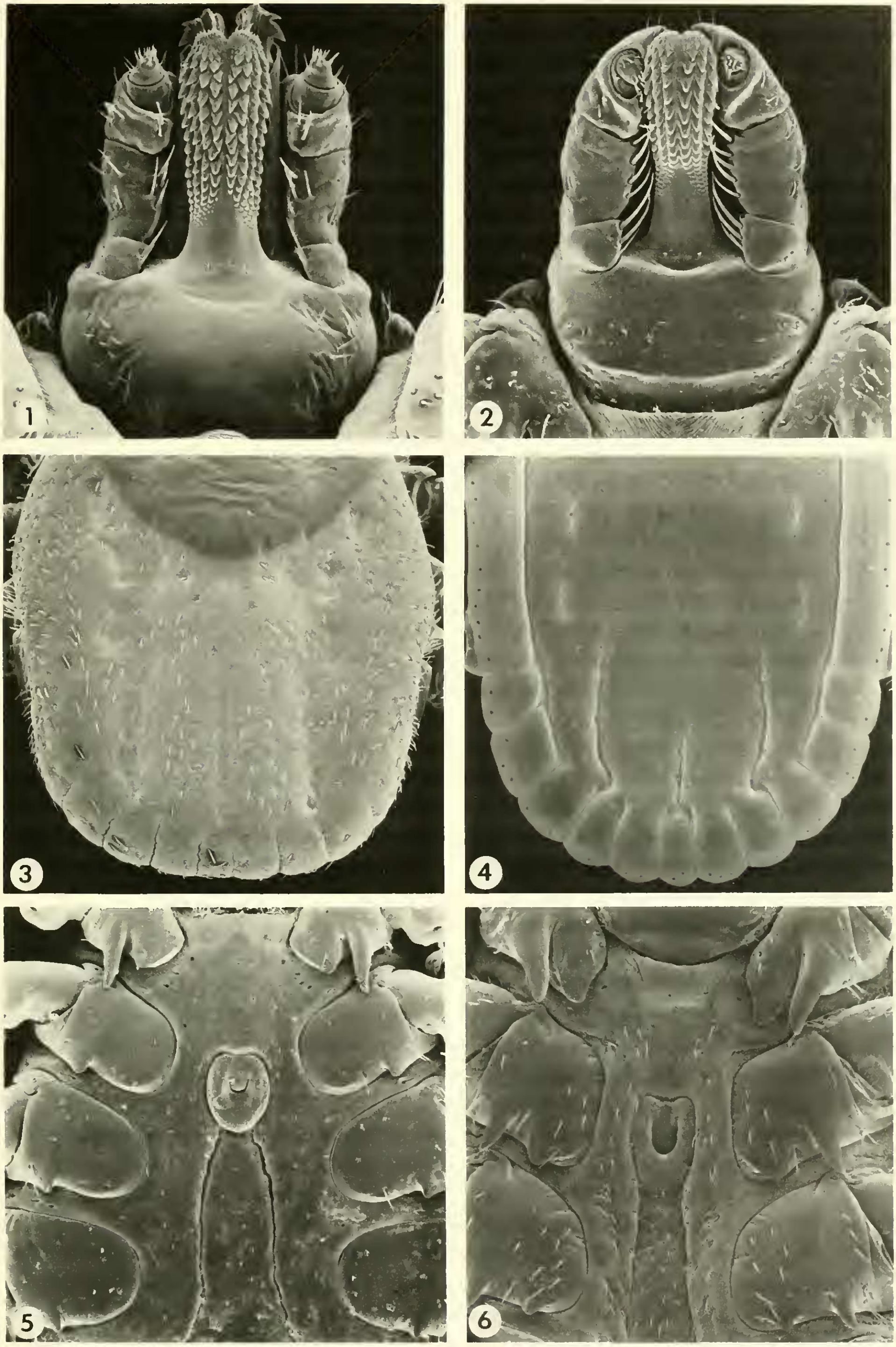
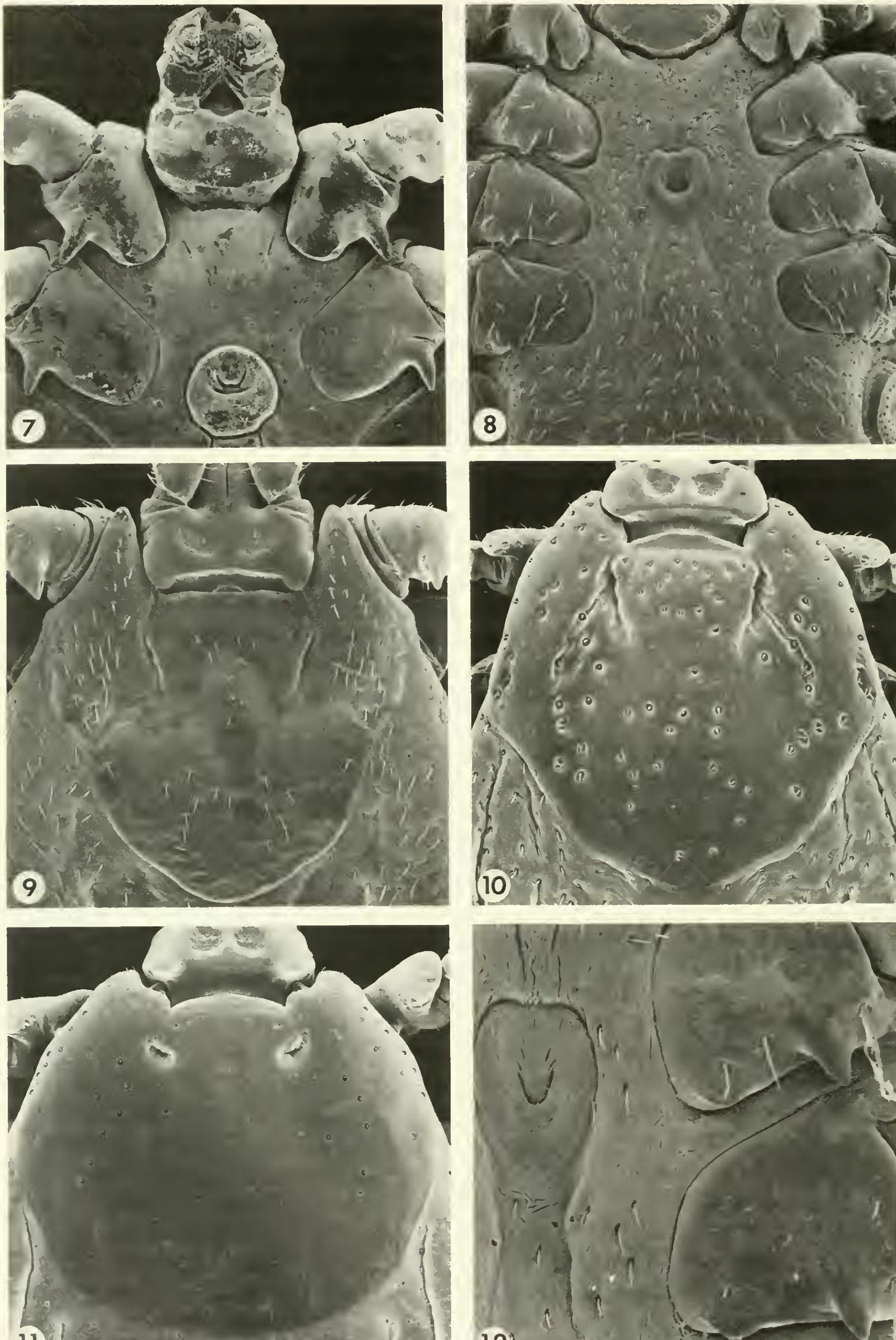
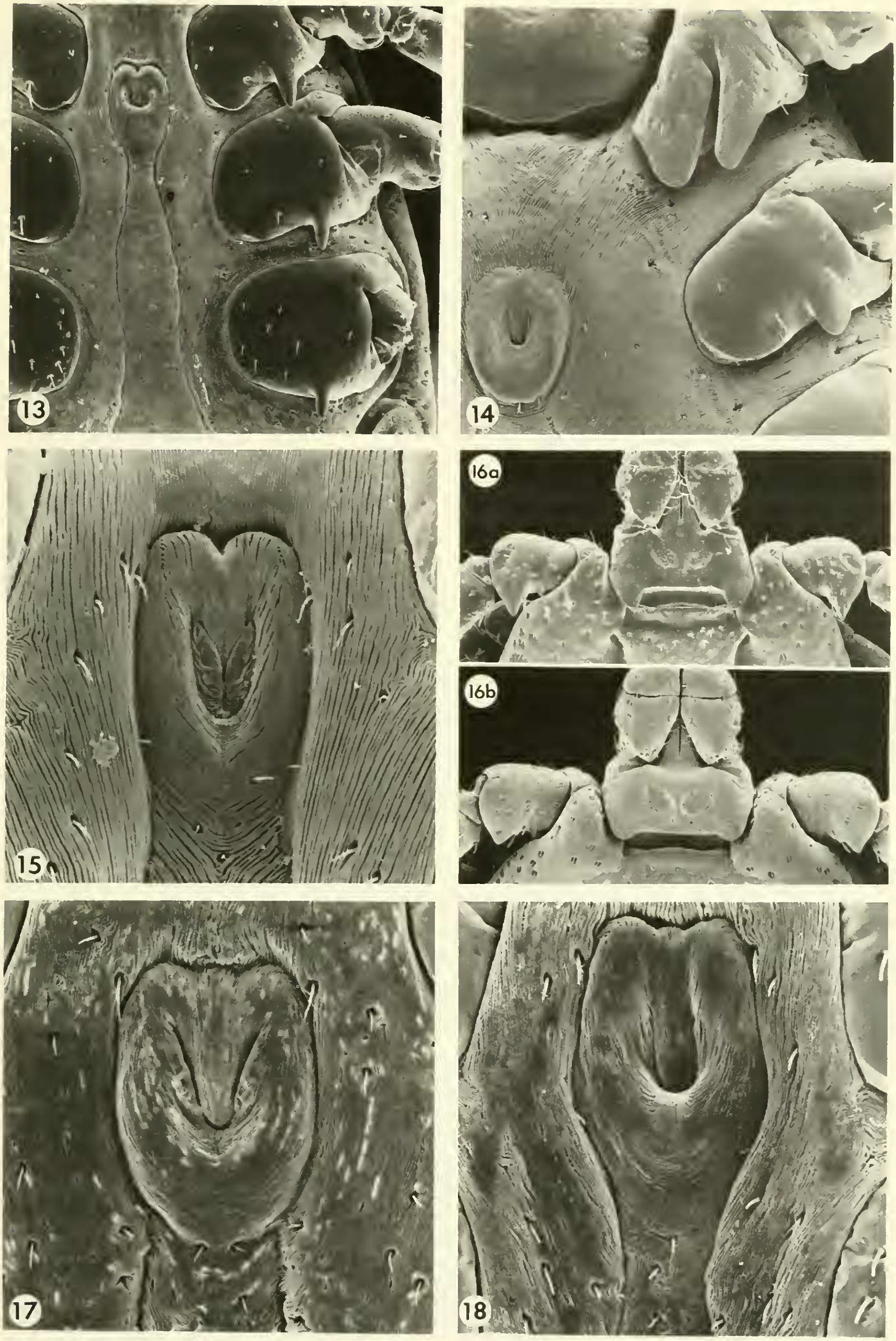


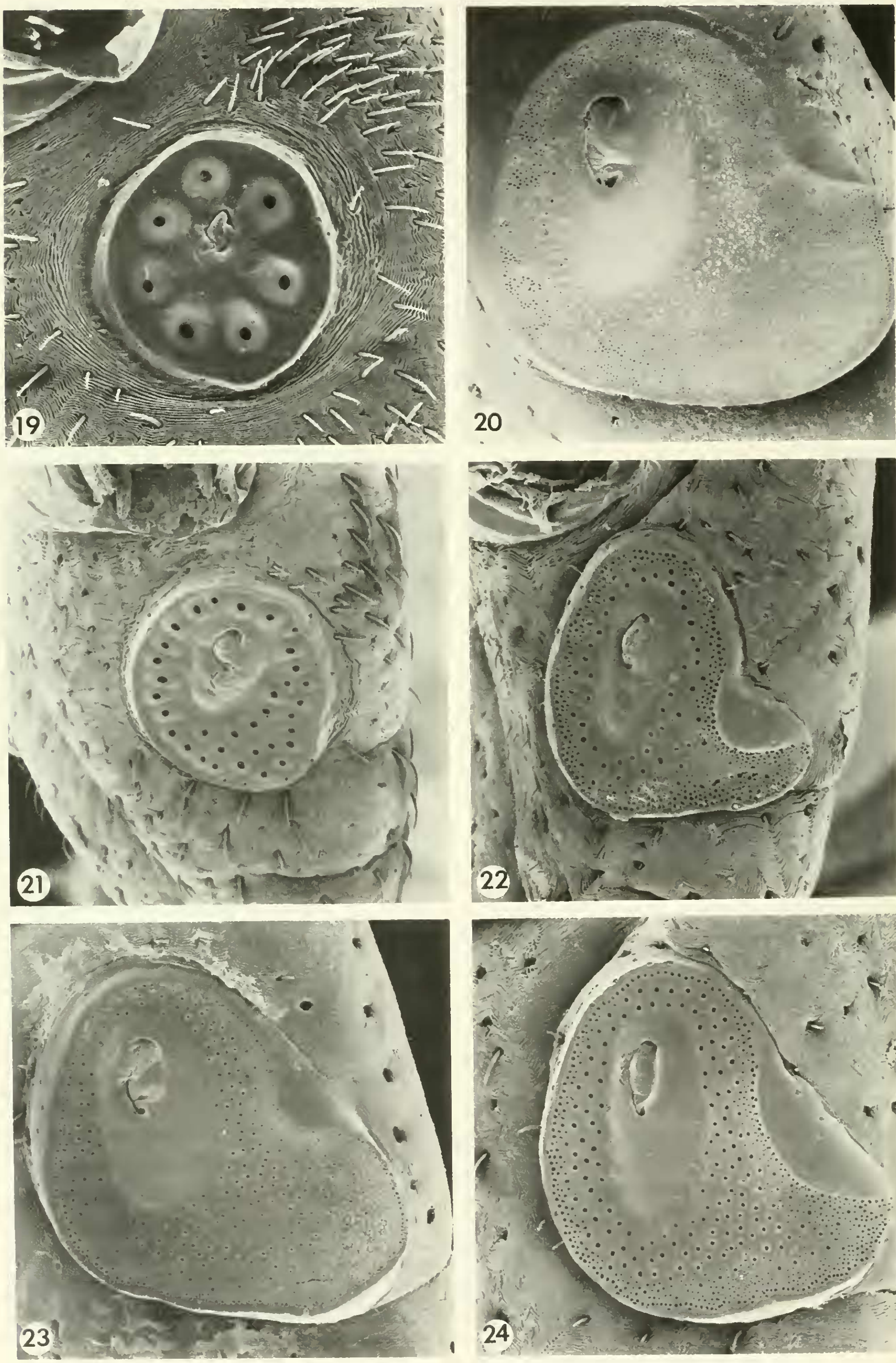
Figs. 1–6. ♀ *Dermacentor* spp. 1, *D.* (*Anocentor*) *nitens* capitulum, ventral view, 160×. 2, *D.* (*D.*) *imitans*, capitulum, ventral view, 160×. 3, *D.* (*A.*) *nitens*, festoons, dorsal view, 70×. 4, *D.* (*D.*) *imitans*, festoons, 70×. 5, *D.* (*D.*) *imitans*, coxae I–IV and genital opening, 68×. 6, *D.* (*D.*) *albipictus*, coxae I–III and genital opening, 77×.



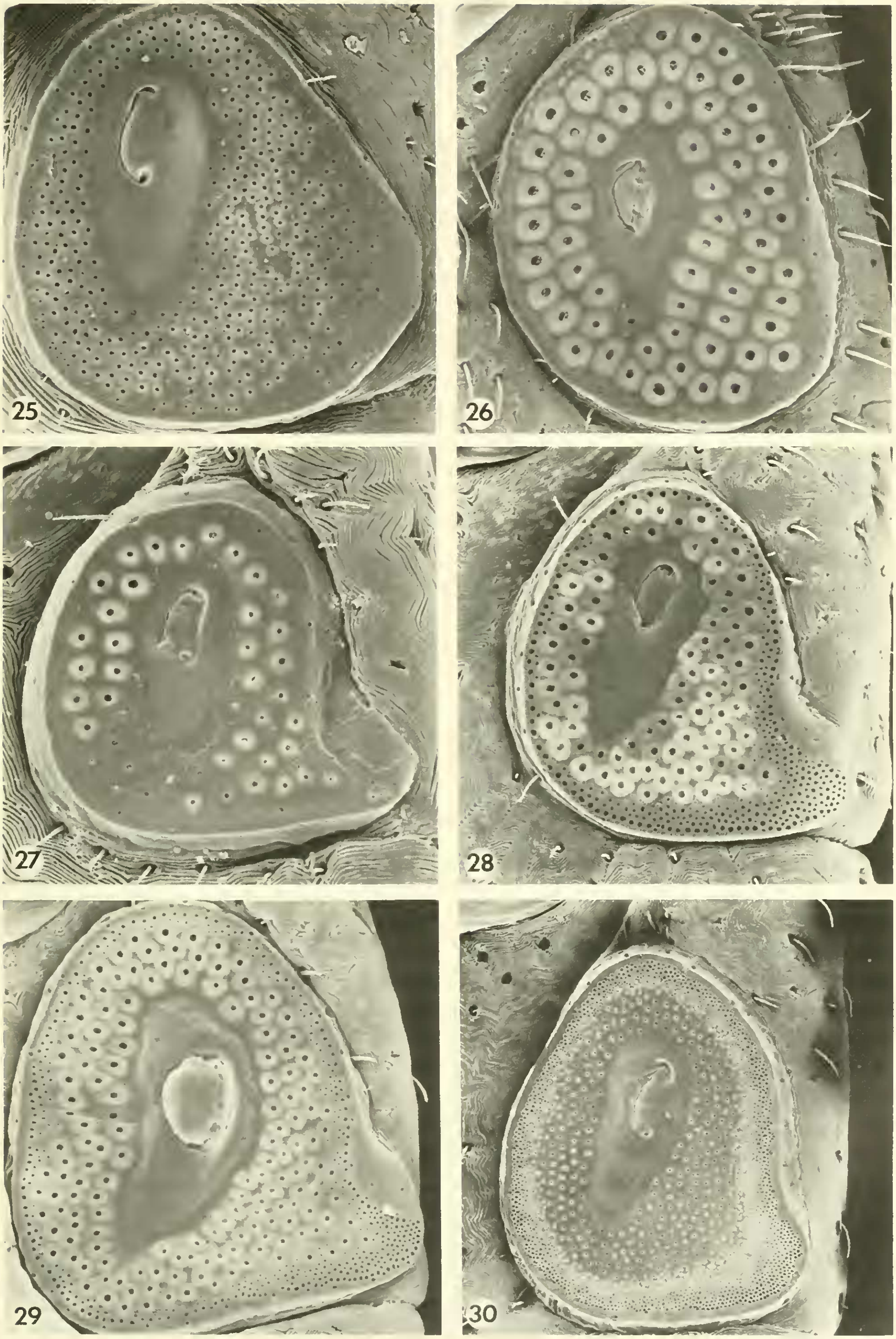
Figs. 7–12. ♀ *Dermacentor* (*Dermacentor*) spp. 7, *D. dispar,* venter of capitulum, coxae I and II and genital opening, 53×. 8, *D. dissimilis,* coxae I–IV and genital opening, 72×. 9, *D. dissimilis,* scutum, 90×. 10, *D. parumapertus,* scutum, 77×. 11, *D. imitans,* scutum, 67×. 12, *D. parumapertus,* coxae II and III and genital opening, 188×.



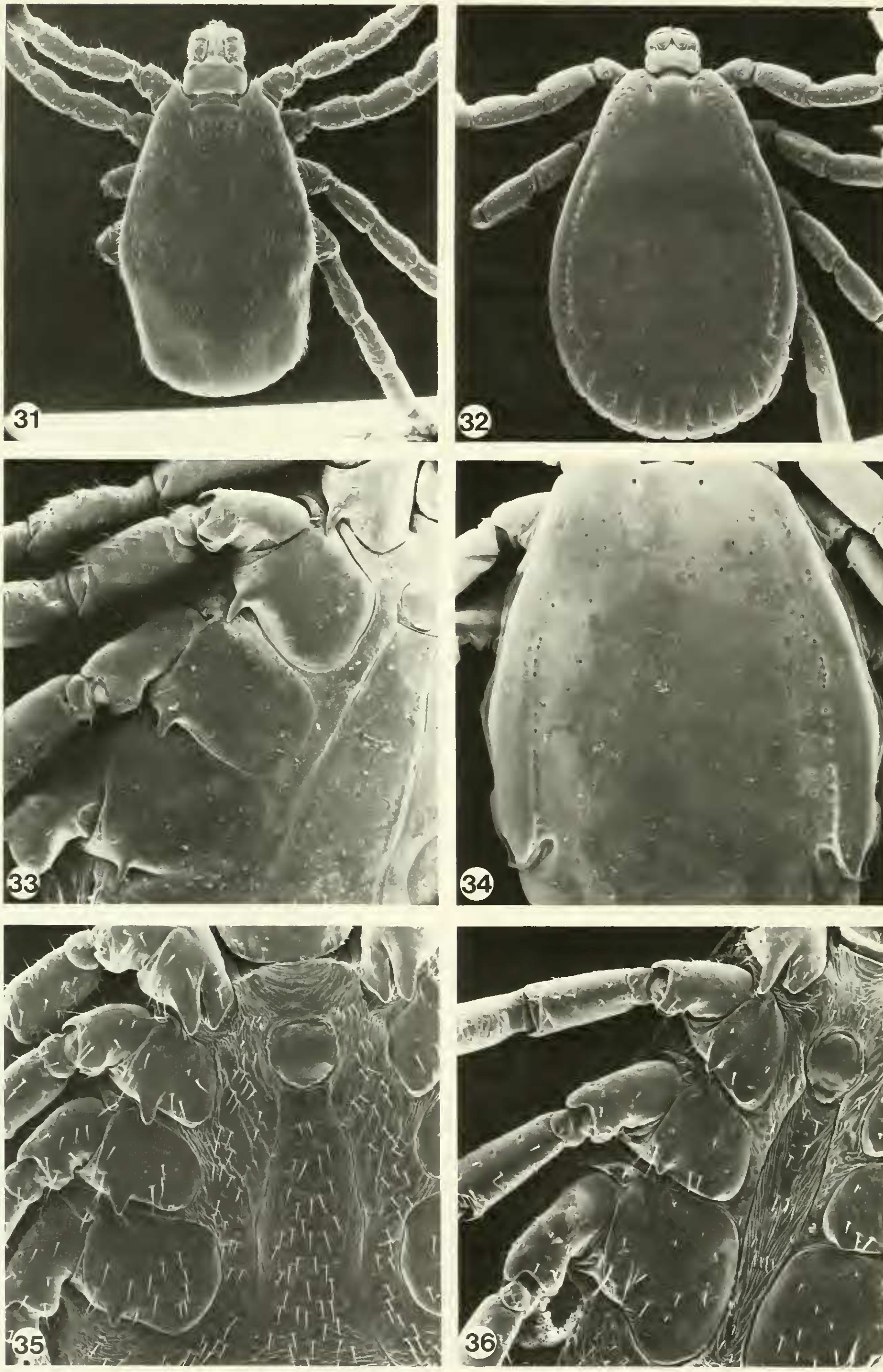
Figs. 13–18. ♀ *Dermacentor* (*Dermacentor*) spp. 13, *D. halli,* coxae II–IV, genital opening, 76×. 14, *D. latus,* coxae I and II, genital opening, 85×. 15, *D. hunteri,* genital opening, 200×. 16a, *D. occidentalis,* anterodorsal aspect, showing spurs of trochanter I and cornua, 62×. 16b, *D. andersoni,* anterodorsal aspect, showing spurs of trochanter I and cornua, 58×. 17, *D. occidentalis,* genital opening, 220×. 18, *D. andersoni,* genital opening, 240×.



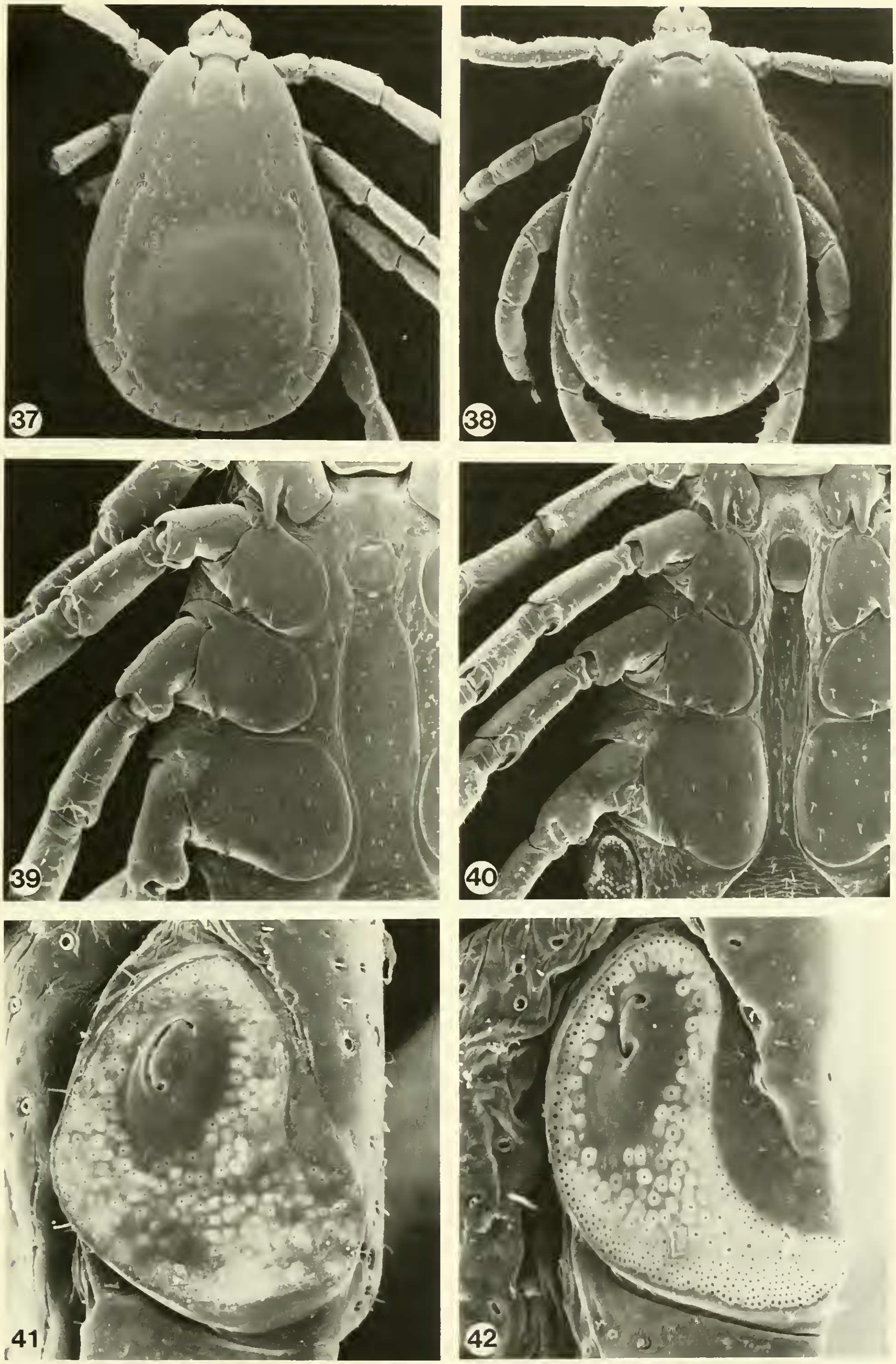
Figs. 19–24. ♀ *Dermacentor* spp., left spiracular plates. 19, *D.* (*Anocentor*) *nitens*, 190×. 20, *D.* (*D.*) *dispar*, 180×. 21, *D.* (*D.*) *dissimilis*, 200×. 22, *D.* (*D.*) *parumapertus*, 200×. 23, *D.* (*D.*) *imitans*, 220×. 24, *D.* (*D.*) *halli*, 220×.



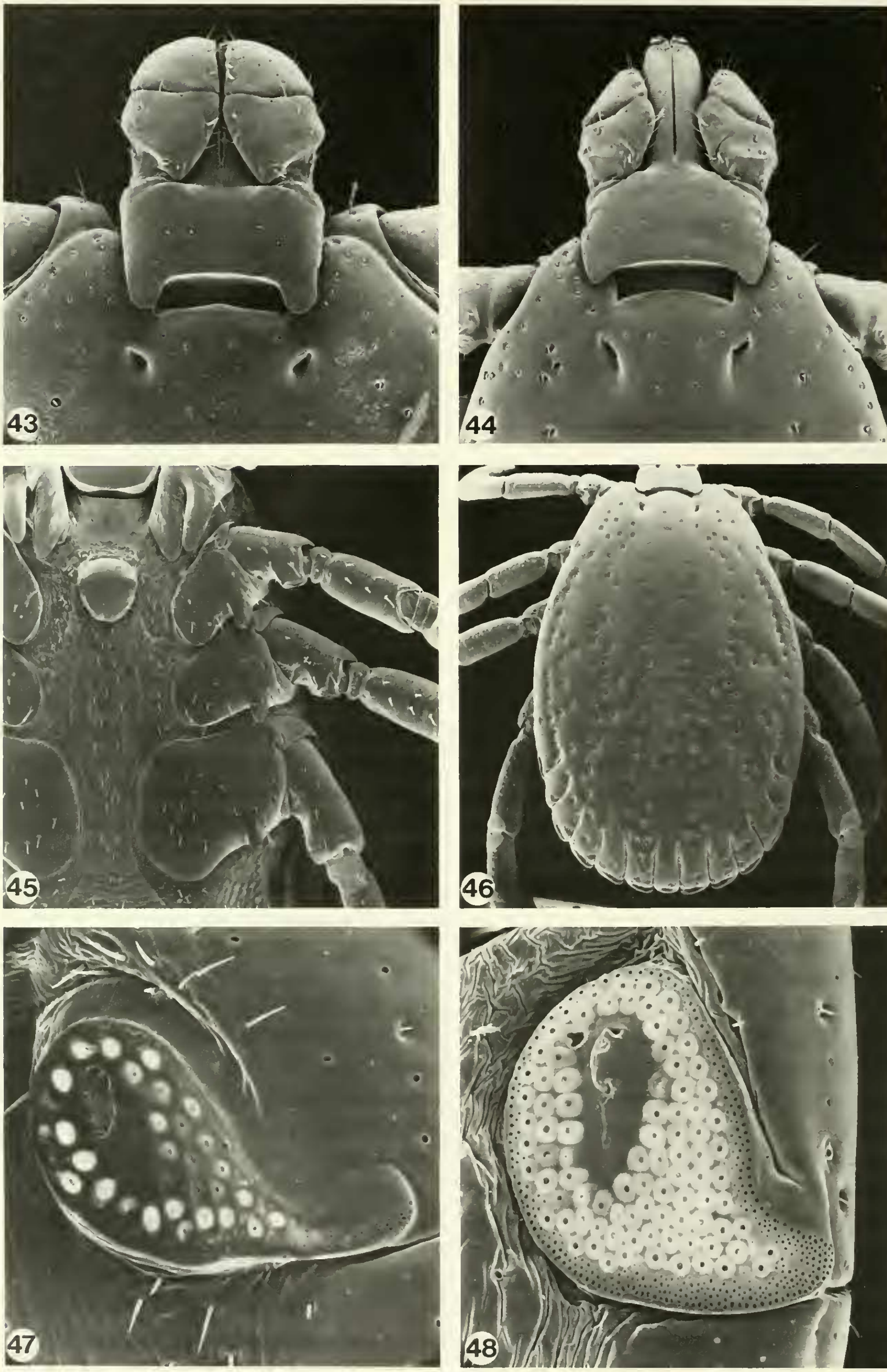
Figs. 25–30. ♀ *Dermacentor* (*Dermacentor*) spp., left spiracular plates. 25, *D. latus,* 190×. 26, *D. albipictus,* 190×. 27, *D. hunteri,* 240×. 28, *D. occidentalis,* 240×. 29, *D. andersoni,* 190×; *D. variabilis,* 190×.



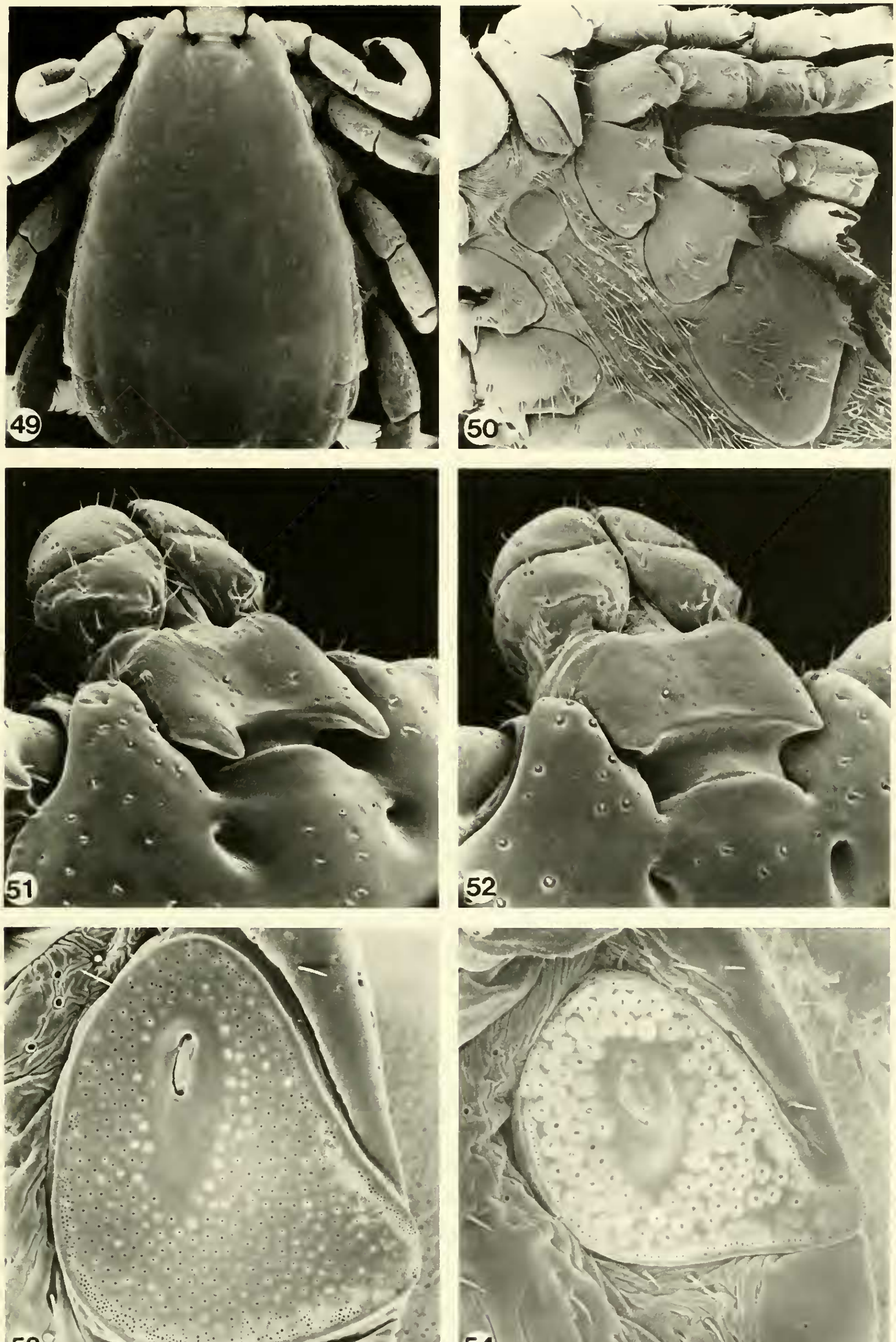
Figs. 31–36. ♂ *Dermacentor* spp. 31, *D.* (*Anocentor*) *nitens*, dorsum, 32×. 32, *D.* (*D.*) *hunteri*, dorsum, 21×. 33, *D.* (*D.*) *dispar*, coxae I–IV, 32×. 34, *D.* (*D.*) *dispar*, dorsum, 32×. 35, *D.* (*D.*) *dissimilis*, coxae I–IV, 74×. 36, *D.* (*D.*) *parumapertus*, coxae I–IV, 64×.



Figs. 37–42. ♂ *Dermacentor* (*Dermacentor*) spp. 37, *D.* (*D.*) *parumapertus*, dorsum, 32×. 38, *D.* (*D.*) *occidentalis*, dorsum, 21×. 39, *D.* (*D.*) *imitans*, coxae I–IV, 42×. 40, *D.* (*D.*) *halli*, coxae I–IV, 42×. 41, *D.* (*D.*) *imitans*, left spiracular plate, 212×. 42, *D.* (*D.*) *halli*, left spiracular plate, 212×.



Figs. 43–48. ♂ *Dermacentor* (*Dermacentor*) spp. 43, *D.* (*D.*) *imitans,* capitulum, dorsal view, 74×. 44, *D.* (*D.*) *halli,* capitulum, dorsal view, 74×. 45, *D.* (*D.*) *latus,* coxae I–IV, 32×. 46, *D.* (*D.*) *latus,* dorsum, 21×. 47, *D.* (*D.*) *hunteri,* left spiracular plate, 212×. 48, *D.* (*D.*) *occidentalis,* left spiracular plate, 212×.



Figs. 49–54. ♂ *Dermacentor* (*Dermacentor*) spp. 49, *D.* (*D.*) *albipictus*, dorsum, 21×. 50, *D.* (*D.*) *albipictus*, coxae I–IV, 64×. 51, *D.* (*D.*) *occidentalis*, showing elevated cornua, oblique view, 95×. 52, *D.* (*D.*) *andersoni*, showing nonelevated cornua, oblique view, 85×. 53, *D.* (*D.*) *variabilis*, left spiracular plate, 190×. 54, *D.* (*D.*) *andersoni*, left spiracular plate, 190×.